

# (12) UK Patent Application (19) GB (11) 2 101 782 A

(21) Application No 8216246

(22) Date of filing

3 Jun 1982

(30) Priority data

(31) 8122046

8202423

(32) 17 Jul 1981

28 Jan 1982

(33) United Kingdom (GB)

(43) Application published

19 Jan 1983

(51) INT CL<sup>3</sup> G08B 13/02

(52) Domestic classification

G4N 1C3 5A FA

(56) Documents cited

None

(58) Field of search

G4N

G1J

(71) Applicant

United Gas Industries

plc (Great Britain)

216 Rowan Road

Streatham Vale

London SW16 5HX

(72) Inventors

John Arthur Charles

Roy Ernest White

(74) Agents

United Gas Industries

plc

(Eileen Margaret

Betteridge)

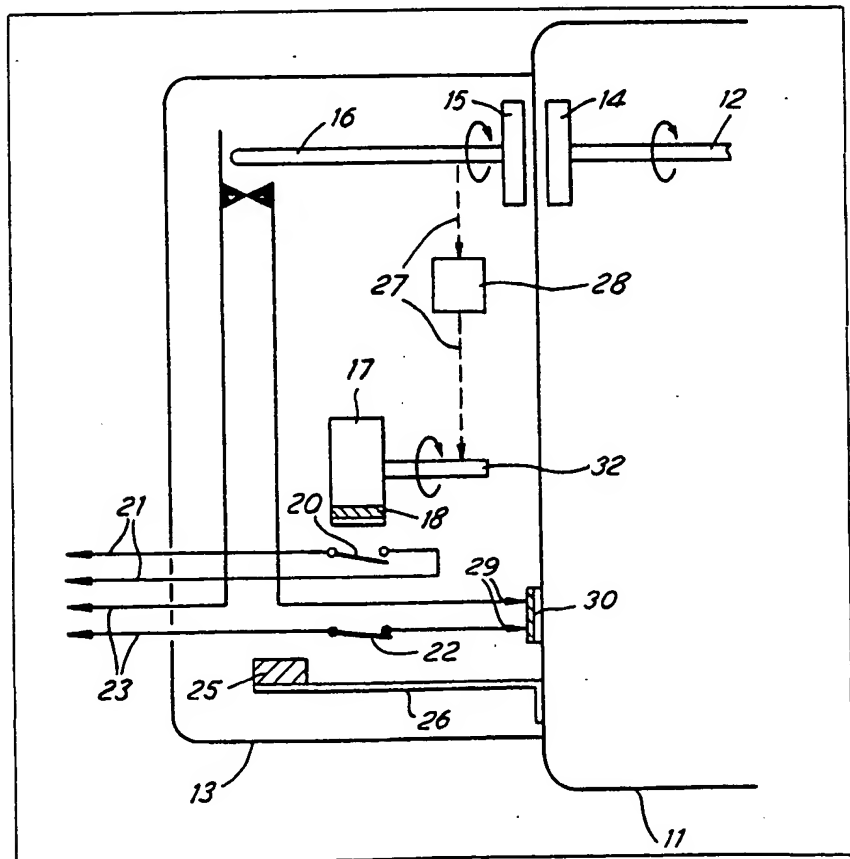
170 Rowan Road

Streatham Vale

London SW16 5JE

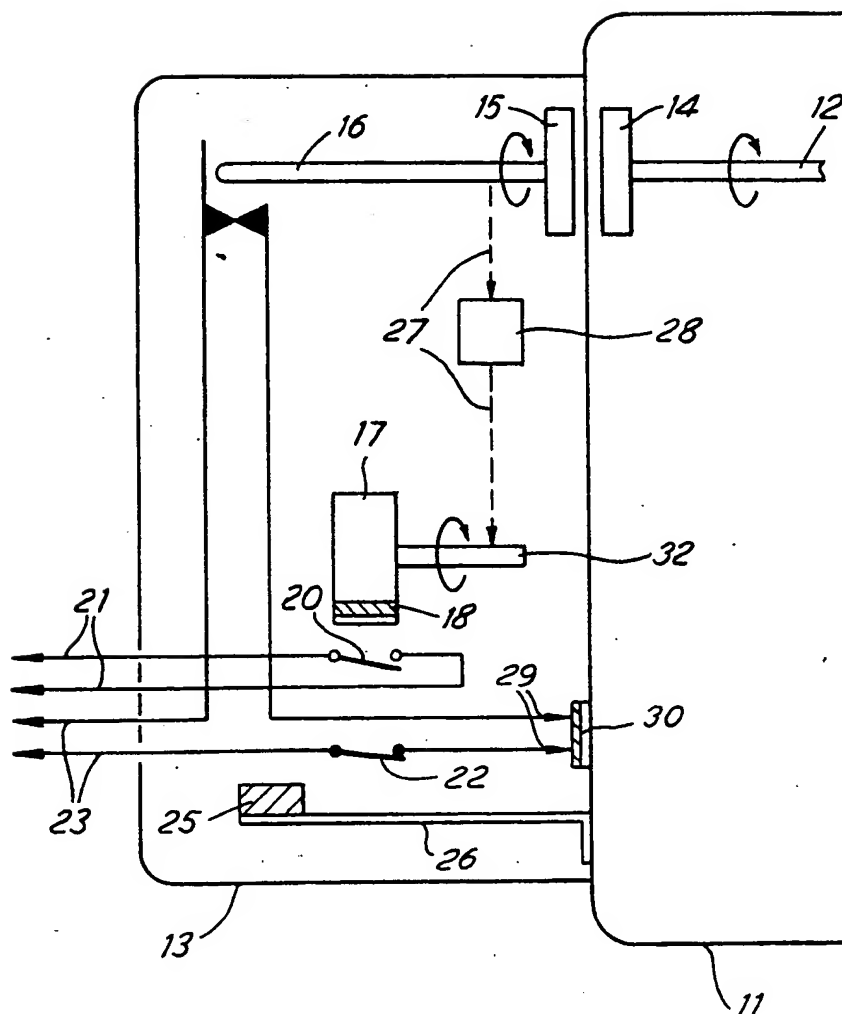
(54) **Commodity meters**

(57) A gas meter (11) has an index housing (13) and a magnetic coupling (14, 15) conveying meter rotation to a magnet (18). A reed switch (20) adjacent the magnet produces an electrical output on lines (21). A further reed switch (22) adjacent switch (20) is connected on another output (23) so that if an external magnet is applied to the housing to interfere with the switch (20), then switch (22) is also operated and detected on lines (23). Other disturbance of the meter may be detected by switches which respectively are operated by attempts to jam the magnetic drive and attempts to remove the meter housing.



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## SPECIFICATION

### Commodity meters

- 5 This invention relates to commodity meters of the kind which measure consumption of a commodity, e.g. gas, water or electricity, and transmit electrical signals indicating the rate of flow to an index which may be adjacent or
- 10 integral with the meter or remote therefrom.

The invention provides a commodity meter having an electrical meter output signal, in which said signal is produced by first magnetically-operable switch means and magnet

- 15 means located closely adjacent said switch means for producing a limited magnetic field such as to operate it at intervals, and a first magnetically-operable disturbance switch also located adjacent said first switch means positioned so as not to be operated by said limited
- 20 magnetic field but so as to be operated by a wider magnetic field embracing both switches.

A specific embodiment of the invention is shown diagrammatically in the accompanying drawing, which comprises a plan sectional view of parts of a gas meter and its index.

- A gas meter (11) is of the kind in which back-and-forth movements of diaphragms is transformed into rotational movement of a
- 30 shaft (12). The meter (11) is sealed to contain the gas and has attached to it an index housing (13) which contains indicating means for determining and displaying the amount of gas used. A magnetic coupling (14, 15) drives
- 35 from the shaft (12) to an index drive shaft (16) which in turn drives a shaft (27), gearbox (28) and a counter mechanism (not shown) and a visible index (not shown) in the index housing.

- 40 Shaft (27) also drives a shaft (32) carrying a rotatable member (17) including a magnet (18) which passes close by a normally open reed switch (20) once in each revolution. Each time the reed switch (20) closes, an electrical
- 45 pulse is produced on output lines (21) which may lead to a remote data logging device. Alternatively, the lines (21) may lead to an interface device which sends signals related to the gas consumption over telephone lines or
- 50 mains electricity supply lines to a central computer.

In such an arrangement, it is possible to interfere with the operation of reed switch (20) by placing an external magnet or magnetic field inducing means so that the switch

- 55 is held permanently closed and no electrical pulses are detected by the remote logging device, and no gas consumption is recorded. To detect such interference, a second, normally closed, reed switch (22) is mounted
- 60 closely adjacent reed switch (20) but on the other side from the magnet (18) so that it is not operated by the magnet. Any external magnet or magnetic field inducing means applied to operate switch (20) will be physically

outside the housing (13) and to be effective on switch (20) will need to have an extensive and powerful magnetic field, much more so than that of magnet (18) which is physically close to switch (20) and therefore requires only a limited field. For instance, the magnet (18) passes less than 0.5 inch away from the contacts of the switch (20), while housing (13) is of the order of 1.5 inches away from it

70 so that any external magnet can only be brought to that distance from the switch, and must therefore be considerably more powerful than the magnet (18). Such an extensive field will embrace switch (22) and will therefore

80 operate it, by opening its contacts at the same time as it closes those of switch (20). Output lines (23) from switch (22) also lead to the remote data logging device and are connected there into a security alarm circuit, such that

85 when switch (22) is opened, the alarm circuit indicates interference with the operation of the gas meter.

Another form of interference with the measurement operation of the meter comprises removing the index housing (13). The reed switches are mounted on the housing, so that removing housing takes the switch (20) away from the vicinity of the magnet (18) and no electrical pulses are transmitted on lines (21).

- 95 To detect this, another magnet (25) is secured to part of the counter mechanism adjacent the path taken by security switch (22) as the index housing (13) is pulled away from the meter. The magnet (25) opens switch (22) as it passes it and gives a signal on lines (23) that interference has taken place. As an alternative to the magnet (25), there may be a two-pole socket mounted on the meter wall and a plug connected to lines (23). The
- 100 contacts of the socket are connected together and insulated from the meter casing. As the index housing (13) is pulled away from the meter, the plug is disconnected from the socket and the lines (23) go open circuit, so
- 105 indicating that there has been interference. An alternative to the plug and socket comprises a contact pair (29) which are normally closed by a contact pad (30) secured to but insulated from the meter casing.

- 115 Another form of interference is disconnection of the magnetic coupling (14, 15) by the insertion of a stiff wire into the index housing to jam gear box (28) or the counter mechanism of the shaft (16). When magnet (15) is thus stopped, magnet (14) continues to rotate. Magnets (15) and (14) are magnetised in a pattern of alternate N and S poles which in normal operation lie adjacent poles of the opposite polarity. When magnet (14) rotates
- 120 by one pole's width relative to magnet (15) like poles lie adjacent one another and a repelling force occurs between the magnets of the coupling. The magnet (15) and shaft (16) are mounted so that when this repelling force
- 130 is experienced an axial movement away from

the magnet (14) takes place. In this movement the shaft (16) opens a security switch (31) either directly or indirectly, so producing an interference signal on lines (23).

- 5 Alternatively, the axial movement of magnet (15) may operate a reed switching device.

The circuit shown in the drawing may be replaced by the logic circuit described in our co-pending patent application 82 16245

- 10 whereby the four leads (21, 23) may be replaced by two leads and appropriate resistances and a logic device in the data logging device or interface.

- 15 While the specific example described above is concerned with a gas meter, the invention is applicable to other commodity meters, e.g. water or electricity meters in which an electrical output is provided.

## 20 CLAIMS

1. A commodity meter having an electrical meter output signal, in which said signal is produced by first magnetically-operable switch means and magnet means located closely adjacent said switch means for producing a limited magnetic field such as to operate it at intervals, and a first magnetically operable disturbance switch also located adjacent said first switch means, positioned so as not to be operated by said limited magnetic field but so as to be operated by a wider magnetic field embracing both switches.
2. A commodity meter as claimed in claim 1, wherein said first switch means lies sandwiched between said magnet means and said disturbance switch.
3. A commodity meter as claimed in claim 1 or claim 2, wherein said disturbance switch is connected in an electrical circuit having output lines from the meter.
4. A commodity meter as claimed in claim 3, wherein said circuit includes one or more other disturbance switches arranged to be operated on the occurrence of different forms of disturbance.
5. A commodity meter as claimed in claim 4, comprising a meter body and an index housing secured to but removable from said body, said first switch means, magnet means and disturbance switch or switches being mounted in said index housing.
6. A commodity meter as claimed in claim 5, wherein one of said disturbance switches detects removal of the index housing from the meter body, having a pair of contacts one of which moves with the index housing and the other with the meter body.
7. A commodity meter as claimed in claim 5, wherein said index housing carries a second magnet means which is located to be moved adjacent said first disturbance switch during removal movement of the index housing from the meter body.
8. A commodity meter as claimed in claim 5, wherein there is a magnetic drive coupling

between the meter body and the index housing including magnet means within the index housing as the driven member thereof, and another of said disturbance switches comprises contacts which are operated by movement of said driven member due to a repelling force from a drive member in the meter body.

9. A commodity meter as claimed in any of claims 3 to 8, wherein said electrical meter output signal and signals from said disturbance switch or switches are taken from the meter over two output lines as claimed in any claim of co-pending patent application 82 16245.

10. A commodity meter substantially as described hereinbefore with reference to the accompanying drawing.

Printed for Her Majesty's Stationery Office  
by Burgess & Son (Abingdon) Ltd.—1983.  
Published at The Patent Office, 25 Southampton Buildings,  
London, WC2A 1AY, from which copies may be obtained.